Control #: D4-300-102

Acrobat 8.0

FACILITY STATUS CHANGE FORM

Date Submitted:	Area:	Control #:
March 3, 2015	300 Area	D4-300-102
Originator:	**Facility ID:**	
Chris Strand	309	
Phone:	**Action Memorandum:**	
554-2720	Action Memorandum #3	

This form documents agreement among the parties listed below on the status of the facility D&D operations and the disposition of underlying soil in accordance with the applicable regulatory decision documents.

Section 1: Facility Status

☐ All D4 operations required by action memo complete.

☒ D4 operations required by action memo partially complete, remaining operations deferred.

Description of Completed Activities and Current Conditions:

Deactivation: Utility isolations were performed on the facility prior to beginning facility decontamination.

The following hazardous materials were removed prior to facility demolition: oils, batteries, Freon, lights, light ballasts, asbestos containing materials, mercury switches, glycols, tritium exit signs, lead, and radioactive materials. Hazardous material removal and waste disposition was performed in accordance with *Removal Action Work for 300 Area Facilities*, DOE/RL-2004-77, Revision 2 (RAWP). Asbestos removal was conducted by certified asbestos workers.

Demolition: Above-grade demolition of the 309 Plutonium Recycle Test Reactor was completed in 2014. Below-grade and removal of structures that included the reactor core, tanks, piping, ion exchange vaults, rupture loop annex, IEM cell, south annex and the fuel storage basis were completed January 2015. The 309 primary containment vessel was removed to -32 feet below-grade, with the rest of the structure remaining in place. All demolition debris and facility components (e.g., reactor core) were removed and disposed of at ERDF. The demolition was performed under radiological and Industrial Hygiene controls.

Description of Deferral (as applicable):

GPERS surveys and backfill of the 309 excavation are deferred to completion of remedial actions associated with waste sites 300-22, UPR-300-5, and 300-255.

Section 2: Underlying Soil Status

☐ No waste site(s) present. No additional actions anticipated.

☒ Documented waste site(s) present. Cleanup and closeout to be addressed under Record of Decision.

☐ Potential waste site discovered during D4 operations. Waste site identification number <to be> assigned.

Cleanup and closeout to be addressed under Record of Decision.

Description of Current/As-Left Conditions:

The lower 309 primary containment vessel remains in place at -32 feet at the bottom of the excavation. The excavation remains open with access restricted through radiological and industrial hygiene postings.

Identification of Documented Waste Site(s) or Nature of Potential Waste Site Discovery (as applicable):

300-22 (309 Building B-Cell Clean-out Leak)
UPR-300-5 (309 Fuel Storage Basin Overflow)
300-255 (309 Tank Farm Contaminated Soil)

Section 3: List of Attachments

1. Facility information (building history, characterization, demolition and identification of documented waste sites).
2. Project photographs.
3. -32 Foot Containment Structure GPERS Surveys.

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4. -32 Foot Containment Structure Civil Survey.
5. -32 Foot Containment Structure and Adjacent Soils Characterization Plan.
6. -32 Foot Containment Structure and Adjacent Soils Data Summary Report.

DOE-RL	3/4/15 Date
Lead Regulator ☒ EPA ☐ Ecology	3/18/15 Date

DISTRIBUTION:

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Document Control, H0-30
Administrative Record, H6-08 (300-FF-2 OU)

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D4 EPL: Chris Strand, L5-45
Sample Design/Cleanup Verification: Theresa Howell, H4-23
FR Engineering: Eric Ison, L5-45
FR EPL: Chris Strand, L5-45

Attachment 1: Facility Information

Building History

309 Plutonium Recycle Test Reactor

The PRTR was an 85 vertical tube, heavy water moderated, light water cooled, 70 MW nuclear reactor that operated from 1960 to 1968. The PRTR first went critical on November 21, 1960 and its last full power operating day was July 13, 1968. A secondary test reactor, the Critical Test Facility (CTF) was added to the east wing of the 309 Building in 1962 to support the PRTR operations and later to support commercial nuclear reactor fuel management data needs. The CTF was operated until 1976 when fuel management computer models replaced the need for the fuel performance measurements.

The PRTR was operated in support of the Plutonium Utilization Program to develop an optimum reactor fuel design for recycling plutonium to stretch the uranium fuel supply for commercial nuclear reactors. In 1963, operation of the Fuel Element Rupture Test Facility (FERTF) was started using one of the standard 10 cm (4 in) diameter PRTR process tubes with up to 2 wt. % plutonium oxide. Fuel and fuel cladding tests were done at elevated operating temperatures and with pre-defected fuel to evaluate fuel design limits. In April 1965, the FERTF test loop was connected to the largest, central PRTR tube No.1550 that was about 18 cm (7 inch) diameter. Fuel performance testing continued at increasingly higher enrichments and higher fuel temperatures including partially molten conditions beginning in May 1965.

On September 29, 1965, while operating a pre-defected UO_2-4 wt. % PuO_2 fuel rod at 1,790 KW power level, a serious fuel failure accident occurred. About 75% of the fuel rod radius was molten when the pin hole enlarged to 5/8-inch, the fuel rod ruptured, and the surrounding FERTF/PRTR process tube was breached. The breaching of the process tube contaminated the helium gas in the space between the process tube and the aluminum shroud tube. Fission gases released during the rupture traveled through the helium system and into the HEPA filtration system for the process off-gases. Airborne contamination reached 20 R/hr within the reactor main hall (i.e., contained by the dome). But the most serious contamination was within the primary and secondary coolant systems due to the fuel material released. Calculations determined that 705 grams of fuel (about half of the rod's contents) was released, grossly contaminating the PRTR's heavy water coolant and moderator with fission products, mixed oxide fuel, and light water (i.e., FERTF coolant).

Following the fuel failure, reactor recovery involved gross decontamination of the operating area, removal of the fuel element and process tube, and finally a detailed decontamination of the operating area that required a total of six (6) months. The PRTR was restarted in July 1966 and operated until mid-1968 when it was shut down for a valve replacement. However, before the repairs were completed, the Atomic Energy Commission (AEC) decided to shut down the PRTR program to pursue an alternate breeder reactor technology.

The PRTR layaway and decommissioning began in 1969 and was completed in November 1969. The fuel was removed and reprocessed on site, the heavy water was shipped to the Savannah River Plant, and the removal of major equipment for reallocation or burial was begun. From 1970 to 1975, the PRTR deactivation continued with the deactivation of the major associated facilities and the associated concrete structures in 1975.

In 1975, the Interim Examination and Maintenance (IEM) cell was built within the old maintenance and mockup cell area in the west wing. The IEM included a tower at the east end of the west wing. The IEM was an exact "cold" replica of the operating cell in the FFTF reactor and was used to train and requalify operators and to check operating procedures.

During the PRTR deactivation, the CTF operation was continued until 1976 for the AEC and the Nuclear Regulatory Commission's support of the commercial nuclear energy programs. The CTF's closure came when computational tools for nuclear reactor fuel management became advanced enough to replace the need for the PRCF's testing capabilities. In 1988 to 1989, the CTF hardware and equipment were removed and disposed of in the 200 Area burial grounds.

In 1986-87, a new space technology development program known as SP-100 was assigned to the 309 Building. The implementation of the SP-100 Ground Engineering System Test Facility involved an extensive cleanout of old PRTR facilities, the installation of the 3701U Guard Station in the northwest corner of the 309 Area and enclosure of the 309 facilities within a fenced security area. In 1991, the SP-100 program was placed on a 5-year "hold" and subsequently terminated by the DOE in November 1993 which brought about the transition of the facility for deactivation.

The 309 facilities were located in the south central 300 Area between Arizona Street on the west, New Mexico Street on the east, Locust street on the north, and Cypress street on the south below 309 Area parking lot. The distinctive round PRTR dome was a 300 Area landmark.

After completion of hazardous material removal and component stabilization, demolition began in 2011 with removal of the containment dome and demolition of the south and east annexes. Following this first phase of demolition, the next two years were devoted primarily to removal of the 309 reactor core. This was accomplished by wire sawing the concrete around the outside of the biological shield and then lifting the reactor from below-grade with a heavy lift assembly. After the reactor was removed, the final phase of demolition was initiated and included explosive fracturing of the substantial below-grade concrete structures located inside the primary containment vessel and standard demolition of associated and adjacent structures. This final phase of demolition was completed in January of 2015. The only remaining 309 structure consists the lower containment vessel concrete monolith at the -32 foot level. The lower containment structure and adjacent soils underwent closure characterization sampling through January of 2015 (reference Attachment 5). A subsequent evaluation of the data established that protectiveness of groundwater and the river were achieved (reference Attachment 6). Beta and Gamma Global Positioning Environmental Radiological Surveys (GPERS) were conducted on the -32ft monolith surface (Attachment 3). Radiological contamination was identified; however, core sampling demonstrates residual contamination achieves 300-FF-2 Cleanup Levels. GPERS surveys of adjacent soils will be conducted as part of remedial actions associated with adjacent waste sites.

309 Building Characterization:

Table 1. Summary of Characterization Surveys at 309

Type	Duration	Documented In	Results Summary
Asbestos	Extensive inspection and sampling was conducted throughout the course of building characterization and demolition.	IOMs, laboratory reports, facility assessments, and Hanford Environmental Information System database.	Asbestos containing materials (ACM) were present in almost every conceivable form and function. ACM included, but was not limited to friable Thermal Systems Insulation, non-friable Category I materials (roofing, gaskets, and resilient flooring) and category II non-friable materials (transite, mastics, putty, floor tiles, ceiling panels, etc.)
IH Surveys and Beryllium Characterization	Extensive inspection and sampling was conducted throughout the course of building characterization	IOMs, laboratory reports, facility assessments, and work permits.	IH surveys resulted in controls, posting, and personnel monitoring for heavy metals, beryllium, and asbestos.

	and demolition.		
Radiological Surveys	Extensive radiological surveys and sampling were conducted throughout the course of building characterization and demolition.	IOMs, Radiological Survey Records, Radiological Survey Reports, radiological work permits, and ALARA Design Reviews.	Results ranged across the spectrum of radiological conditions; Radiological Buffer Area, Contamination Area, High Contamination Area, Radiation Area, Radiological Material Area, High Radiation Area, and Airborne Radiation Area..

Identification of Document Waste Sites:

Waste Site Piping

300-214 (retention process sewer), 300-257, and 300-RLWS (radioactive liquid waste sewer) piping was removed within the excavation layback.

Waste Site Soils

300-22 (309 B-Cell cleanout leak) was fully excavated during joint removal and remedial actions.

UPR-300-5 (309 fuel storage basin overflow) was fully excavated during joint removal and remedial actions.

300-255 (309 tank farm contaminated soils) was fully excavated during joint removal and remedial actions.

Rejected Waste Sites

The following rejected WIDS sites were removed as ancillary to 309 demolition:

- 309 Hold-Up Tanks, 309-TW-1, 309-TW-2, 309-TW-3
- 309 Ion Exchange Vaults, 309-WS-1, 309-WS-2
- 309 Brine Pit, 309-WS-3

The following Underground Injection Control wells were decommissioned and entirely removed during demolition and remediation:

- 300-75 (French drain)
- 300-77 (French drain)
- 300-87 (French drain)

Anomalies Discovered During Demolition:

No true anomalies were discovered during demolition and remediation. A casing from long-decommissioned ground water monitoring well 399-4-5 was encountered beneath the south annex basement floor and was removed to the extent of the overall excavation. No other unusual items or soil conditions were observed during demolition and remediation.

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Attachment 2: Project Photographs

Photograph 1. Aerial photograph showing the 309 Reactor, view facing west (circa 1980s).

Photograph 2. Aerial photograph showing the primary containment dome removed, view facing west (1/19/11).

Photograph 3. Aerial photograph showing above-grade demolition progress, view facing south (10/20/11).

Photograph 4: Aerial photograph showing completion of above-grade demolition and preparations for reactor core removal, view facing west (9/10/13).

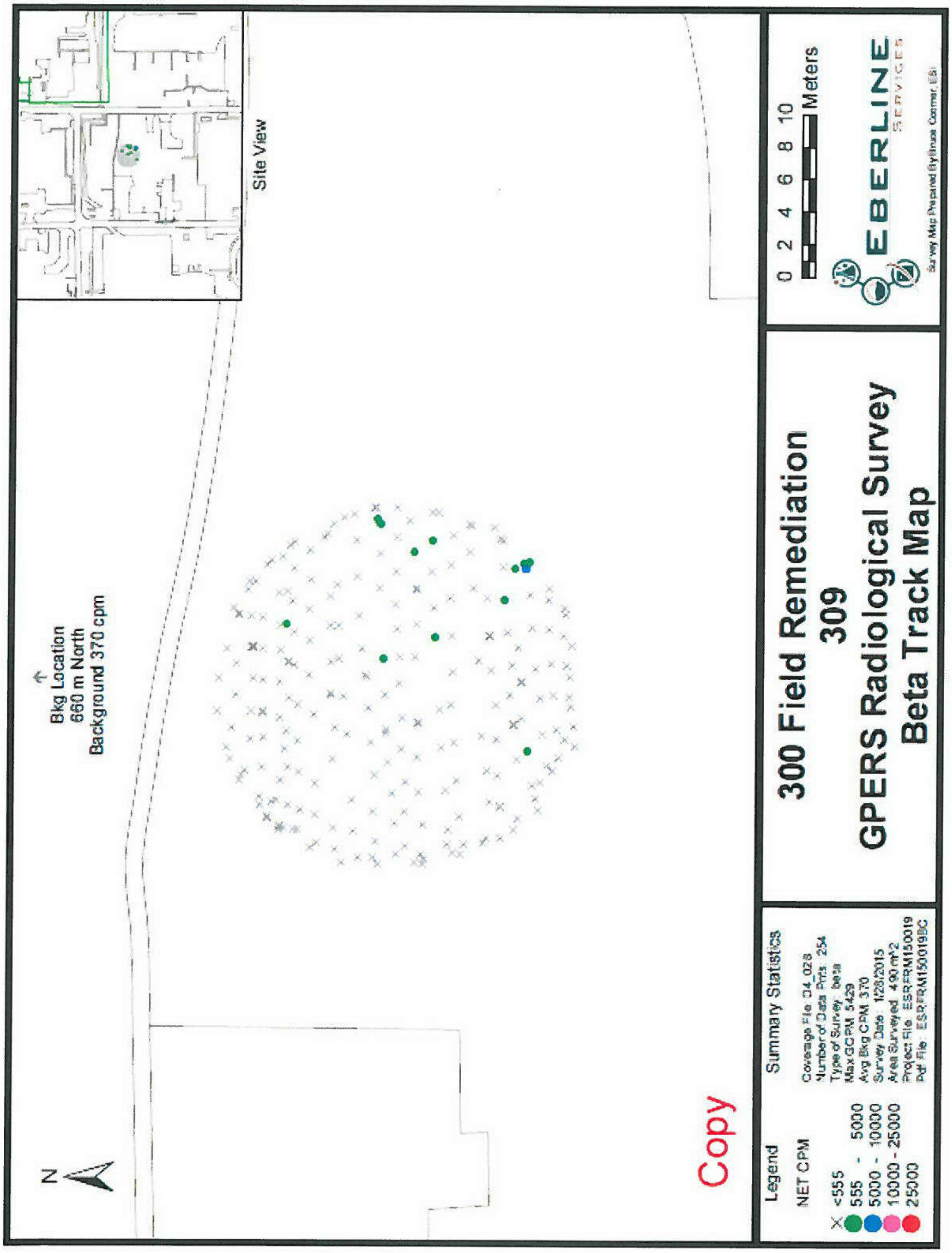
Photograph 5: Aerial photograph showing the heavy lift assembly in preparation for reactor core removal, view facing east (1/15/14).

Photograph 6: Reactor core lift, view facing west (1/21/14).

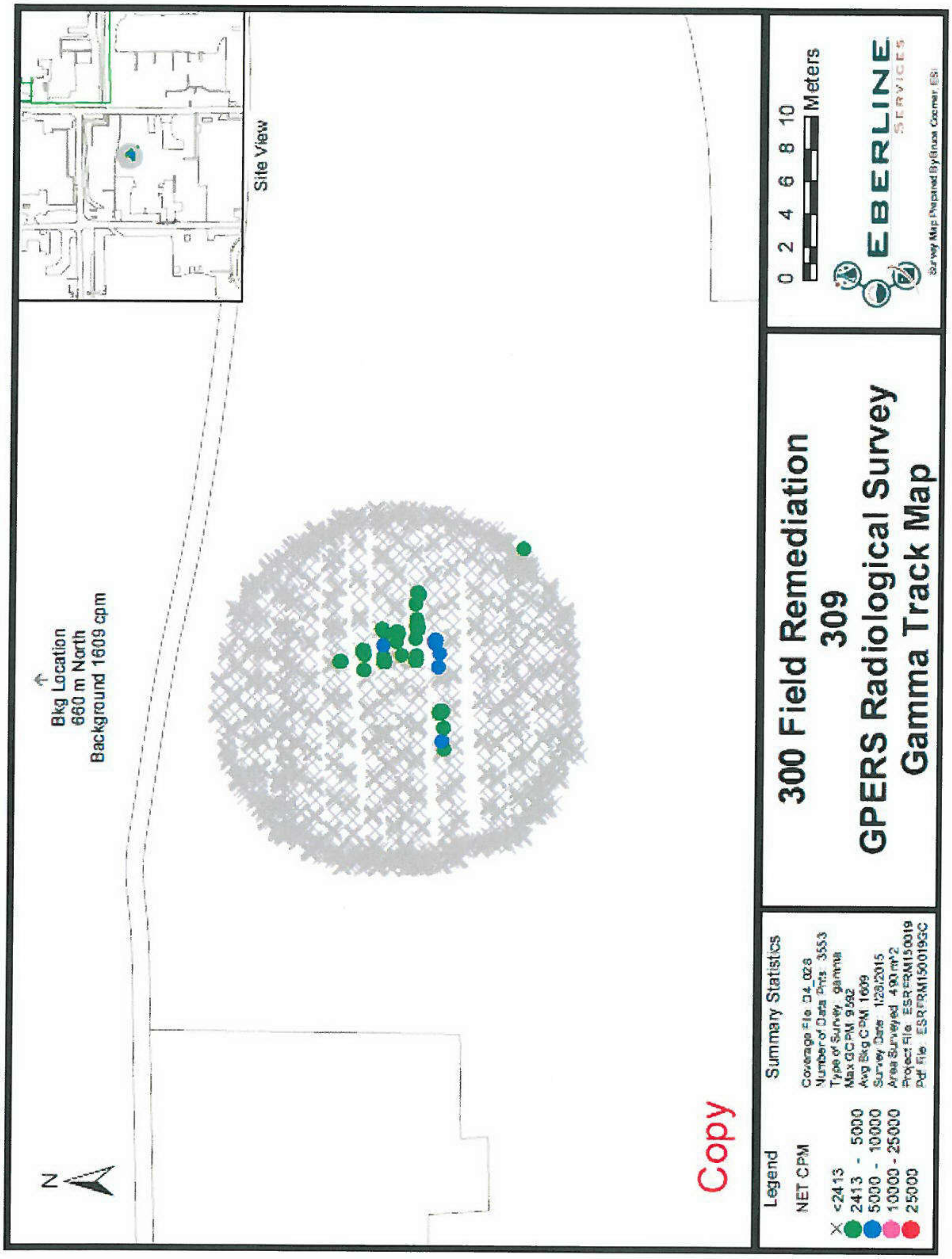
Photograph 7: 309 primary containment following explosive fracturing, view facing northeast (9/29/14).

Photograph 7: -32 foot primary containment monolith, view facing south (2/24/15).

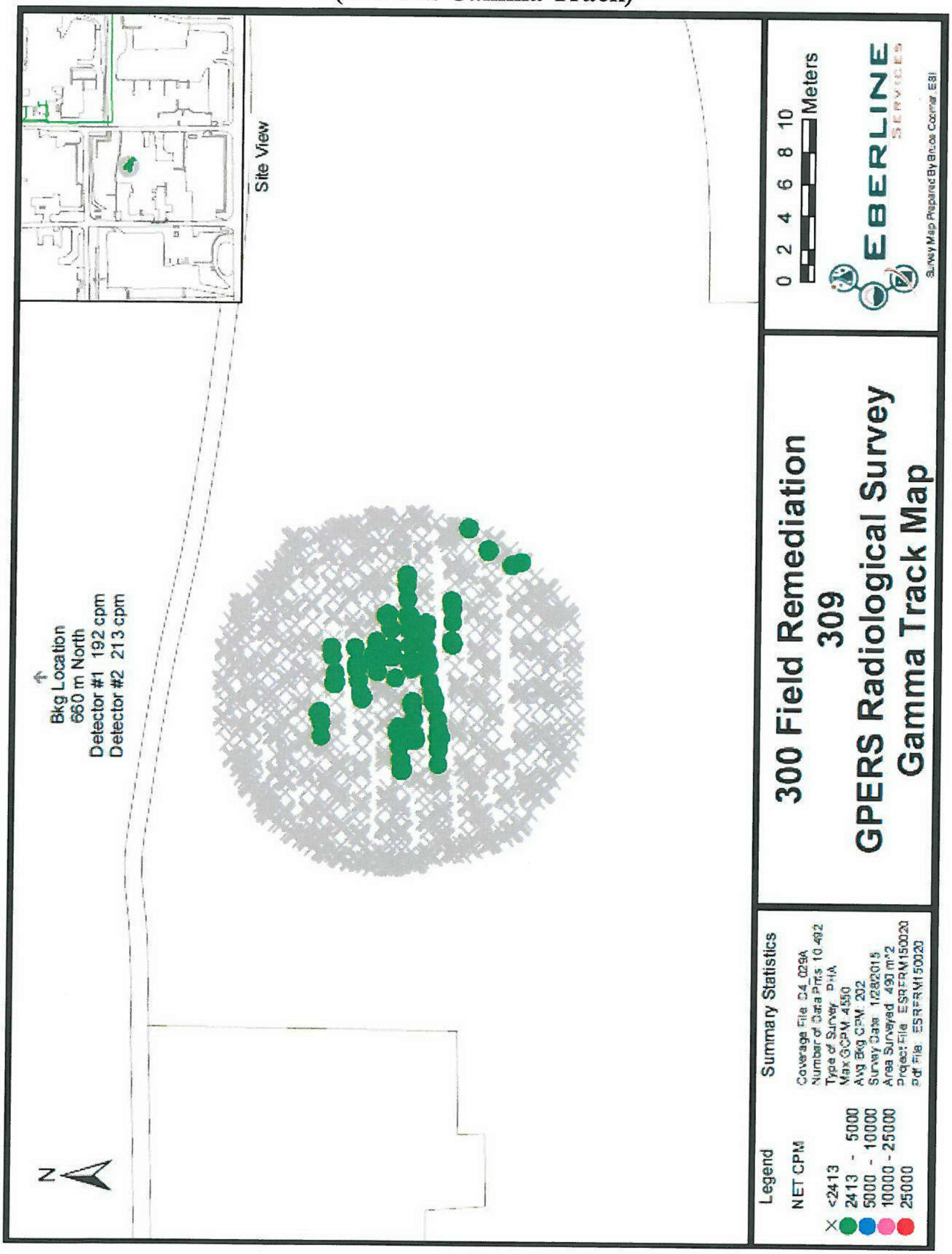
Attachment 3: -32 Foot Containment Structure GPERS Surveys (Beta Track)



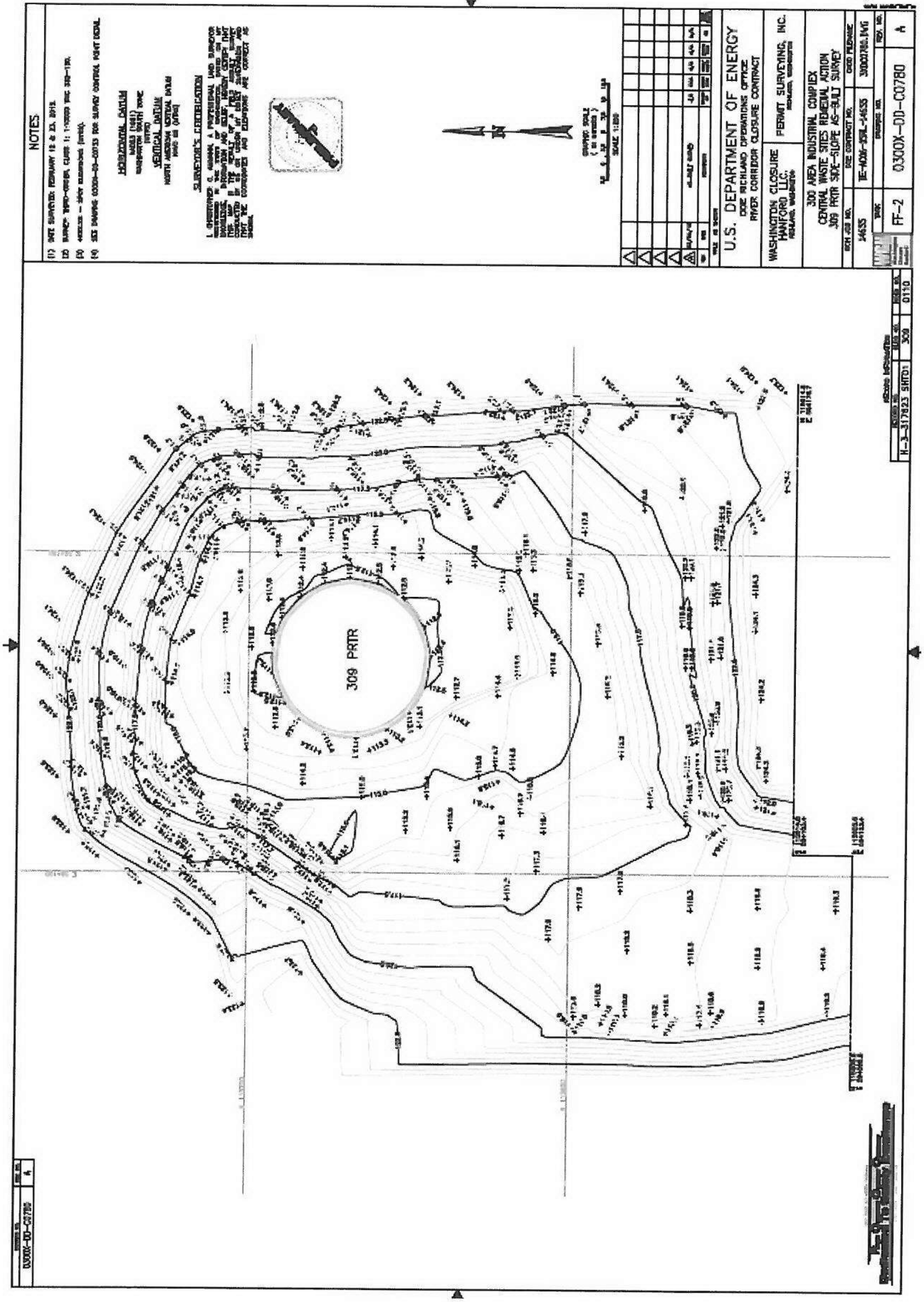
-32 Foot Containment Structure GPERS Surveys
(Gamma Track)



-32 Foot Containment Structure GPERS Surveys
(Am-241 Gamma Track)



Attachment 4: -32 Foot Containment Structure Civil Survey



Attachment 5: -32 Foot Containment Structure and Adjacent Soils Characterization Plan

1.0 INTRODUCTION

The 309 Plutonium Recycle Test Reactor and associated structures (309 Facility) is presently being demolished pursuant to a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, non-time-critical removal action and in accordance with the *Removal Action Work Plan for 300 Area Facilities* (RAWP), DOE/RL-2004-77, Rev. 2.

The objective of this characterization plan is to establish the scope and protocols that will be used to evaluate deep zone soils and structures associated with the 309 Facility following removal actions taken to date. The deep zone within the context of the *Hanford Site 300 Area, Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1* (300 Area Final ROD) (EPA 2013), is the vadose area that is 15 feet or greater below ground surface. Following characterization sampling of remaining structures and soils, resultant data will be used to determine whether or not removal action goals have been met. The determination will be made by performing a direct comparison of remaining deep zone contaminants to the 300 Area Final ROD, Table 4: Cleanup Levels for 300-FF-2 Contaminants of Concern (COCs) – Soils, Structures, and Debris.

If it is established that removal action goals have been met, the remaining 309 Facility structures and adjacent soils will be left in place and undergo closure. Closure of below-grade facility structures will be performed in accordance with the RAWP, Section 2.6, Site Completion. It is noted that adjacent soils associated with waste sites 300-22, UPR-300-5, and 300-255 will be addressed separately under the closure processes established in the 300 Area Final ROD.

2.0 FACILITY HISTORY

The PRTR was an 85 vertical tube, heavy water moderated, light water cooled, 70 MW nuclear reactor that operated from 1960 to 1968. The PRTR first went critical on November 21, 1960 and its last full power operating day was July 13, 1968. A secondary test reactor, the Critical Test Facility (CTF) was added to the east wing of the 309 Building in 1962 to support the PRTR operations and later to support commercial nuclear reactor fuel management data needs. The CTF was operated until 1976 when fuel management computer models replaced the need for the PRCF fuel performance measurements.

The PRTR was operated in support of the Plutonium Utilization Program to develop an optimum reactor fuel design for recycling plutonium to stretch the uranium fuel supply for commercial nuclear reactors. In 1963, operation of the Fuel Element Rupture Test Facility (FERTF) was started using one of the standard 10 cm (4 in) diameter PRTR process tubes with up to 2 wt. % plutonium oxide. Fuel and fuel cladding tests were done at elevated operating temperatures and with pre-defected fuel to evaluate fuel design limits. In April 1965, the FERTF test loop was connected to the largest, central PRTR tube No.1550 that was about 18 cm (7 inch) diameter. Fuel performance testing continued at increasingly higher enrichments and higher fuel temperatures including partially molten conditions beginning in May 1965.

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Following the fuel failure, reactor recovery involved gross decontamination of the operating area, removal of the fuel element and process tube, and finally a detailed decontamination of the operating area that required a total of six (6) months. The PRTR was restarted in July 1966 and operated until mid-1968 when it was shut down for a valve replacement. However, before the repairs were completed, the AEC decided to shut down the PRTR program to pursue an alternate breeder reactor technology.

The PRTR layaway and decommissioning began in 1969 and was completed in November 1969. The fuel was removed and reprocessed on site, the heavy water was shipped to the Savannah River Plant, and the removal of major equipment for reallocation or burial was begun. From 1970 to 1975, the PRTR deactivation continued with the deactivation of the major associated facilities and the associated concrete structures in 1975.

In 1975, the Interim Examination and Maintenance (IEM) cell was built within the old maintenance and mockup cell area in the west wing. The IEM includes the visible tower at the east end of the west wing. The IEM is an exact "cold" replica of the operating cell in the FFTF reactor and is still used to train and requalify operators and to check operating procedures.

During the PRTR deactivation, the PRCF operation was continued until 1976 for the AEC and the NRC (Nuclear Regulatory Commission)'s support of the commercial nuclear energy programs. The PRCF's closure came when computational tools for nuclear reactor fuel management became advanced enough to replace the need for the PRCF's testing capabilities. In 1988 to 1989, the PRCF hardware and equipment was removed and disposed of in the 200 Area burial grounds.

In 1986-87, a new space technology development program known as SP-100 was assigned to the 309 Building. The implementation of the SP-100 Ground Engineering System Test Facility involved an extensive cleanout of old PRTR facilities, the installation of the 3701U Guard Station in the northwest corner of the 309 Area and enclosure of the 309 facilities within a fenced security area. In 1991, the SP-100 program was placed on a 5-year "hold" and subsequently terminated by the DOE in November 1993 which brought about the transition of the facility for deactivation.

The 309 facilities were located in the south central 300 Area between Arizona Street on the west, New Mexico Street on the east, Locust street on the north, and Cypress street on the south below 309 Area parking lot. Figure 1 shows the 309 Building and the associated structures. The distinctive round PRTR dome was a 300 Area landmark.

2.1 309 FACILITY DEACTIVATION, DECONTAMINATIN, DECOMMISSIONING AND DEMOLITION (D4) HISTORY

D4 operations began in earnest in 2007 with initial characterization activities, utility isolations, followed by the start of hazardous material removal. Characterization encompassed numerous cycles of sample collection, sample analysis, and data evaluation. This included both radiological and non-radiological constituents. Extensive radiological characterization was performed in order to bound the expected conditions during demolition activities. This was particularly important give the operational history of the reactor that included accidents and upset conditions that resulted in the release of radioactive materials (as discussed previously). Characterization data was also used to model air emissions, develop waste profiles supporting treatment and disposal, as well as establishing personnel protection requirements. Hazardous material removal encompassed a broad spectrum of substances ranging from asbestos, heavy metals, oils, lights/lamps, to radioactive materials.

After completion of hazardous material removal and component stabilization, demolition began in 2011 with removal of the containment dome and demolition of the south and east annexes. Following this first phase of demolition, the next two years were devoted primarily to removal of the 309 PRTR. This was accomplished by wire sawing the concrete around the outside of the biological shield and then lifting the reactor from below-grade with a heavy lift assembly. After the reactor was removed, the final phase of demolition was initiated and included explosive fracturing of the substantial below-grade concrete structures located inside the primary containment vessel and standard demolition of associated and adjacent structures. This final phase of demolition has proceeded through October 24, 2014. Currently, the primary containment vessel, fuel storage basin, and ion exchange vault have been removed to approximately 30 feet below grade. The south and east annexes have been removed in their entirety and the CTF will be removed prior to characterization sampling.

3.0 309 FACILITY CONTAMINANTS OF CONCERN (COC)

Extensive pre-demolition and in-process characterization has established an extensive baseline of data used in establishing COCs for the remaining portion of the 309 Facility. The COCs are primarily radiological that are associated with reactor operations and nuclear fuel, but do include chemical constituents.

Radiological COCs were derived by three principle factors; 1) Pu-O_2 fuel failure, 2) fission products, and 3) activation products. Non-radiological COCs were derived primarily from the presence in facility components (e.g., lead shielding). Table 1 lists the 309 Facility COCs and general source term for each.

Table 1. 309 Facility Contaminants of Concern

Radiological	
Contaminant	General Source
Americium (Am-241)	Fuel failure (Pu-0_2 fuel).
Plutonium (Pu-238, Pu-239, Pu-240, Pu-241)	Fuel failure (Pu-0_2 fuel).
Cesium (Cs-137)	Fission product from reactor operations.
Strontium (Sr-90)	Fission product from reactor operations.
Cobalt (Co-60)	Activation product from reactor operations.
Tritium (H-3)	Activation and fission product from reactor operations.
Non-Radiological	
Contaminant	General Source
Asbestos	Numerous sources, but not limited to; insulation, roofing, flooring, mastics, and putty.
Beryllium	Fuel component.
Cadmium	Control rods and alloy in metals.
Chromium	Alloy in metals.
Lead	Primarily shielding, paint, and pipe joints.

4.0 309 FACILITY DEEP ZONE CHARACTERIZATION

As allowed by the RAWP and Final 300 Area ROD, deep zone contaminants may be left in place provided they meet deep zone CULs. Those contaminants that are not assigned a CUL may remain in the deep zone regardless of concentration.

At the present, all 309 Facility structures have either been entirely removed, or removed to a below-grade elevation of approximately -32 feet. Partial structures remaining include the lower primary containment vessel, the lower fuel storage basin, and the lower ion exchange vault. These structures will be characterized to establish they meet deep zone CULs. In addition, soils in the immediate area, but not associated adjacent with remove, treat, dispose waste sites, will be characterized as well to establish if they meet deep zone CULs.

4.1 309 FACILITY STRUCTURES CHARACTERIZATION

Lower primary containment characterization will consist of boring ten concrete cores at selected locations and obtaining two samples from each core for a total of twenty samples. Each core will be bored between one to two feet below the original floor face, but at a minimum of one foot. The two sample locations on each core include the original floor face, which is a surface with known remaining contamination, and the bottom of the core. The bottom of the core will be sampled in order to examine whether or not tritium contamination diffused into the structural concrete. Tritium is well documented as being a highly mobile radionuclide that is capable of moving through varied media, including certain solids. Figures 1 and 2 identify the lower containment core locations on plan and section views respectively. Both Figures identify the target location the cores and the two target areas for each sample. Table 2 summarizes the structure core sample locations, and sample COCs for each. It is to be noted that the core locations are approximate, interferences with embedded structural steel and certain reinforcing bar configurations may require adjustment to the exact core location.

Concrete cores will not be collected from the lower fuel storage basin and ion exchange vault. Of the three radiological COCs that have deep zone CULs assigned, two (I-129 and Tc-99) have never been detected above trace quantities. Tritium, being the primary deep zone COC would not have been produced in any appreciable quantities during the storage of irradiated fuel or from ion exchange operations. Soils immediately adjacent to both structures will be characterized for any releases from the primary containment vessel.

4.2 309 FACILITY SOILS CHARACTERIZATION

At depth soils will be characterized at selected locations because of past releases from 309 Facility operational upsets. This characterization does not include soils associated with waste sites 300-22, UPR-300-5, and 300-255, which will be addressed separately under the closure processes established in the 300 Area Final ROD.

Soil characterization will consist of excavating six test pits from the -32 foot elevation to approximately an additional 18 to 20 feet (extent of excavator reach). Three samples from each test pit will be collected from the -3 foot, -12 foot, and -18 to 20 foot locations. A total of eighteen samples will be collected from the six test pit. Resultant analytical data will supplement four previous samples collected at the -17 foot elevation. Samples J1V108, J1V109, J1V110, and J1V111 were analyzed exclusively for tritium. Three of the four sample results (J1V108 through J1V110) were non-detect, the fourth sample (J1V11) result was 41.9 pCi/g, which is well below the 21,200 pCi/g deep zone CUL for tritium. Figure 3 consists of an aerial photograph and showing the soil sample locations.

Table 3 summarizes the soils sample locations, and sample COCs for each. COCs will include those that have a deep zone CUL, with the exception of PCBs, VOAs, Semi VOAs. Extensive in-process sampling and monitoring have not identified these COCs above trace levels.

All samples will be collected and analyzed in accordance with the *300 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-2001-48, Rev 3. Analytical results will be used to determine if removal action goals have been met. If results exceed any deep zone CULs, additional removal will be performed.

Table 2. 309 Facility Structure, Contaminants of Concern

Structures		
Sample #	**Sample Location**	**COCs[a]**
Borehole 1, Sample 1	A Cell Floor.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Borehole 1, Sample 2	A Cell Floor.	Tritium (H-3)
Borehole 2, Sample 1	A Cell Moat/Sump.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Borehole 2, Sample 2	A Cell Moat/Sump	Tritium (H-3)
Borehole 3, Sample 1	C Cell Moat.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Borehole 3, Sample 2	C Cell Moat.	Tritium (H-3)
Borehole 4, Sample 1	C Cell Floor	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Borehole 4, Sample 2	C Cell Floor.	Tritium (H-3)
Borehole 5, Sample 1	A Cell Floor.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Borehole 5, Sample 2	A Cell Floor.	Tritium (H-3)
Borehole 6, Sample 1	Moderator Tank Recess Floor.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Borehole 6, Sample 2	Moderator Tank Recess Floor.	Tritium (H-3)
Borehole 7, Sample 1	Moderator Tank Recess Floor.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Borehole 7, Sample 2	Moderator Tank Recess Floor.	Tritium (H-3)
Borehole 8, Sample 1	A Cell Floor.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Borehole 8, Sample 2	A Cell Floor.	Tritium (H-3)
Borehole 9, Sample1	B Cell Moat	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Borehole 9, Sample 2	B Cell Moat	Tritium (H-3)
Borehole 10, Sample 1	B Cell Floor.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Borehole 10, Sample 2	B Cell Floor.	Tritium (H-3)

[a] Only H-3, Id-129, Tc-99, U (total), Cr (VI), Sb, Se, Cn, and Nitrate have deep zone CULs. Remainder of COCs listed will be analyzed for informational purposes only.

Table 3. 309 Facility Soils, Contaminants of Concern

Soils		
Sample Location	**Sample Location**	**COCs[a]**
Test Pit 1, Sample 1	Ion exchange vault.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 1, Sample 2	Ion exchange vault.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 1, Sample 3	Ion exchange vault.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 2, Sample 1	Fuel Storage Basin North.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 2, Sample 2	Fuel Storage Basin North.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 2, Sample 3	Fuel Storage Basin North.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 3, Sample 1	Critical Test Facility	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 3, Sample 2	Critical Test Facility	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 3, Sample 3	Critical Test Facility	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 4, Sample 1	Fuel Storage Basin South.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 4, Sample 2	Fuel Storage Basin South.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 4, Sample 3	Fuel Storage Basin South.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 5, Sample 1	Rupture Loop South.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 5, Sample 2	Rupture Loop South.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 5, Sample 3	Rupture Loop South.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 6, Sample 1	Rupture Loop North.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 6, Sample 2	Rupture Loop North.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.
Test Pit 6, Sample 3	Rupture Loop North.	Am-241, Pu-238, Pu-239, Pu-240, Pu-241, Cs-137, Sr-90, Co-60, H-3, Id-129, Tc-99, Cd, Cr, Cr (VI), Pb, Sb, Se, U (total), Cn, Nitrate.

[a] Only H-3, Id-129, Tc-99, U (total), Cr (VI), Sb, Se, Cn, and Nitrate have deep zone CULs. Remainder of COCs listed will be analyzed for information purposes only.

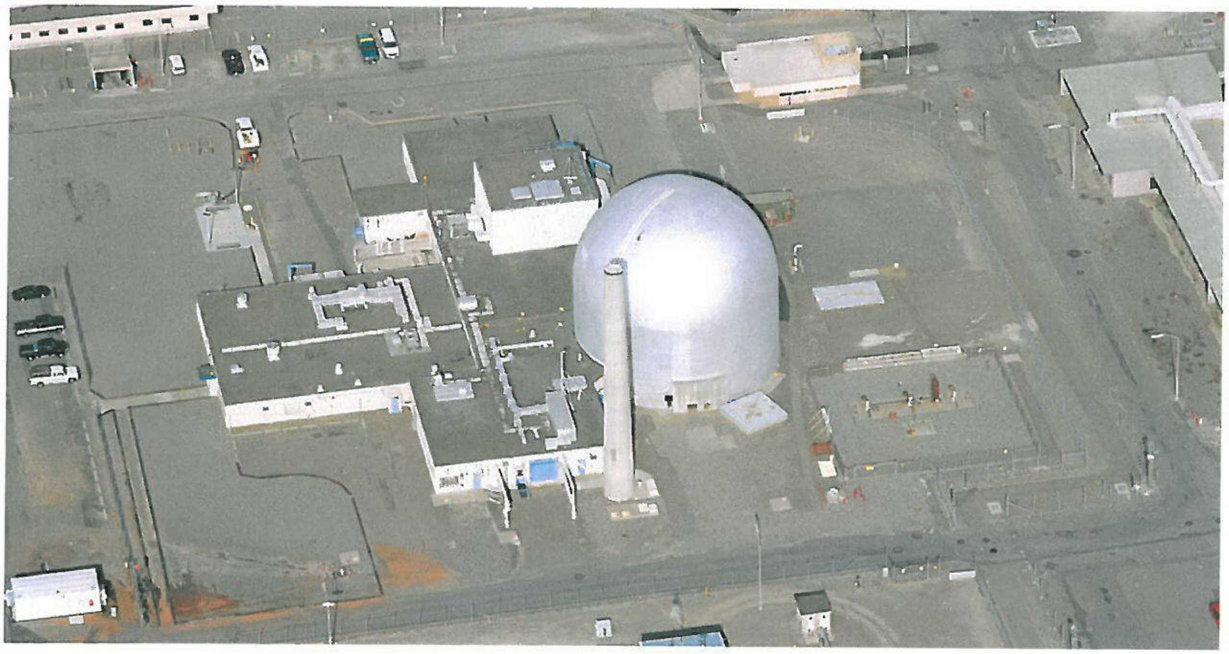
5.0 REFERENCES

DOE/RL-2001-48, 2011, "300 Area Remedial Action Sampling and Analysis Plan", Rev. 3, U.S. Department of Energy, Richland, Washington, January 5, 2011.

DOE/RL-2004-77, 2007, "Removal Action Work Plan for 300 Area Facilities", Rev. 2, U.S. Department of Energy, Richland, Washington, December 18, 2007.

EPA, 2013, *Hanford Site 300 Area, Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1, Hanford Site, Benton County, Washington*, November 2013, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

Photograph 1. Aerial Oblique Photo showing Location of 309 Building, Looking from East to West (circa 1980s).



Photograph 2. 309 Lower Containment Approaching -20 Feet Below Grade (October 22, 2014)

Figure 1. 309 PRTR Structure Sample Locations. Plan View at -32 Foot Location.

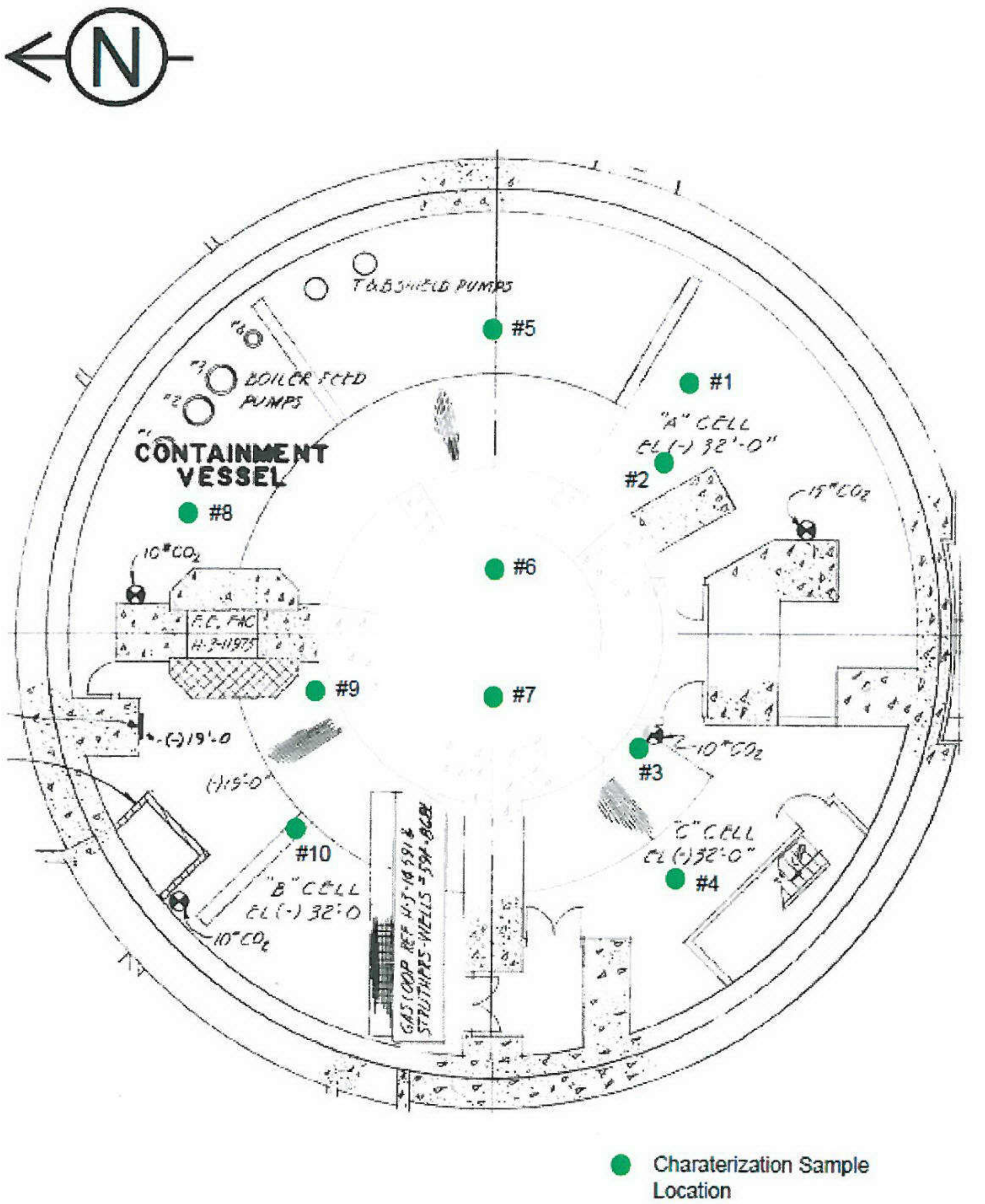


Figure 1 - Plan View of 309 Phase II Foundation - Charaterization Sampling Locations NTS

**Figure 2. 309 PRTR Structure Sample Borehole Locations.
Section View at -32 Foot Location.**

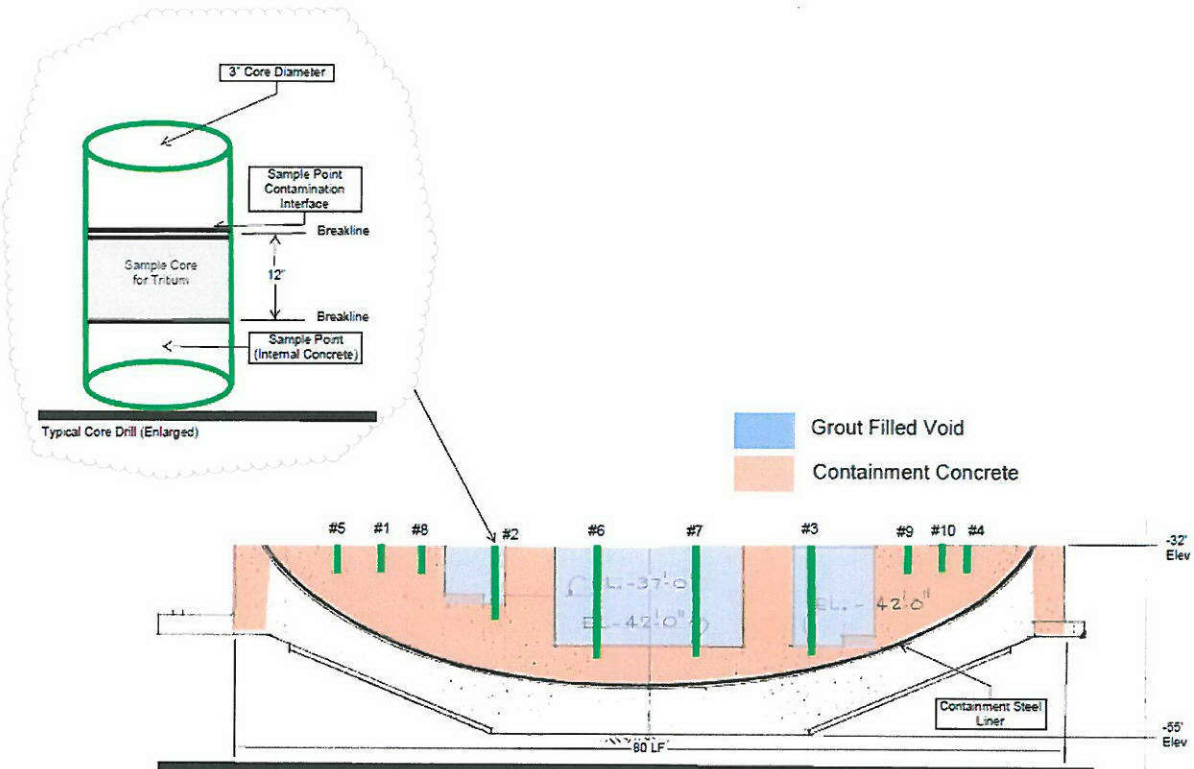


Figure 2 - Elevation View of 309 Phase II Foundation - Charaterization Sampling Locations

Figure 3. 309 Facility Soil Sample Locations.

NOTE: This photograph shows demolition progress as of September 2014, at approximately the -15 foot elevation. Demolition as of November, 2014, has reached the -32 foot elevation. Refer to Table 3 for test pit location descriptions.

Attachment 6: -32 Foot Containment Structure and Adjacent Soils Data Summary Report

<u>309 Building: -32' Concrete Evaluation</u>

The 309 facility is addressed as a removal action under the *Action Memorandum #3 for the 300 Area* and *Removal Action Work* Plan for 300 Area Facilities (RAWP) (DOE/RL-2004-77, Rev. 2). The facility superstructure and much of the substructure has been demolished and removed, and currently only concrete substructure and foundation elements remain, all deeper than 32 feet below grade. The remaining concrete and surrounding soils have been characterized in accordance with the 300 Area SAP and the *Characterization Plan for Deep Zone 309 Plutonium Recycle Test Reactor Soils and Structures.* Results of this sampling are summarized in Attachments 1 and 2 for the concrete structure and soils, respectively.

Section 1.3 of the RAWP states that remaining below-grade structures and underlying soils, when determined to be clean, may require no further action. Sections 2.2 and 2.5 of the RAWP defer to the *300 Area Remedial Design Report/Remedial Action Work* Plan (RDR/RAWP) (DOE/RL-2001-47, Rev. 3) to demonstrate that cleanup objectives have been achieved. All soil sampling results were below the cleanup levels (CULs) established for deep zone soils per the final Record of Decision for the 300 Area. Contaminants detected within the remaining structural concrete were also below soil CULs, with the exception of hexavalent chromium (Cr(VI)) in some concrete samples.

A historical records review found no specific mention of process related use of chromates as corrosion inhibitors in 309 cooling systems. But elevated total chromium was observed in coolant piping during building characterization activities. The presence of hexavalent chromium in the lower reactor space concrete is likely attributable to the release of primary coolant containing a chromate corrosion inhibitor during the fuel rod failure in 1965. This failure ruptured both process and coolant tubes within the reactor core releasing significant contamination throughout reactor areas, including lower spaces. Soil concentrations of Cr(VI) surrounding the 309 facility ranged from undetected to 0.379 mg/kg. Concentrations of Cr(VI) in remaining concrete range from undetected to 9.20 mg/kg. This highest value of 9.20 mg/kg would not fail toxicity characteristic leaching procedure (TCLP) test method as the 20 to 1 dilution could not result in a concentration greater than 5 mg/l even if 100% of the hexavalent chromium were to leach. Concrete core samples were collected from the primary containment structure and indicated that the Cr(VI) was predominately in the surface and upper portion of the concrete, and was not detected at depth. Depths of the cores ranged from 1-2 ft.

These residual concentrations of Cr(VI) bound in concrete are not anticipated to leach to the soil; and soil concentrations surrounding the facility indicate no Cr(VI) above the CUL of 2.0 mg/kg. The development of the default Cr(VI) soil CUL of 2.0 mg/kg primarily rests on precedent in the interim action RDR/RAWP, and is based upon ensuring that hexavalent chromium levels remaining in soil do not result in an exceedance of water quality criteria in the Columbia River. The cleanup model and methodology used for the 300 Area RI/FS calculated a cleanup number of greater than 6 mg/kg in irrigated soils (no modeling for contaminants within concrete was performed). However, the higher calculated value was replaced with a value of 6 mg/kg for the RI/FS because the soil-distribution coefficient (K_d) data being used was derived using soils with a Cr(VI) concentration less than 6 mg/kg. Subsequently, the Proposed Plan opted to propose a CUL of 2.0 mg/kg in soil, based on the soil remedial action goal (RAG) used for the interim action RDR/RAWP.

The interim action RDR/RAWP selected soil groundwater and surface water protection RAGs for metals in soil, including Cr(VI), based on the "100 times rule" under the applicable 1996 version of WAC 173-340-740 and 173-340-745. (This approach is no longer promulgated under the current WAC

173-340 regulations.) In application under the interim action RDR/RAWPs, exceedances of soil RAGs for groundwater and surface water protection trigger additional site-specific evaluations for protectiveness, as provided for by the RDR/RAWPs, and documented with the waste site reclassification documentation. Under these evaluations, residual Cr(VI) concentrations greater than 2.0 mg/kg for multiple large sites in the River Corridor have been demonstrated to be protective.

The leachability of contaminants, including Cr(VI), from concrete is significantly lower than from soils. Further, the residual Cr(VI) in the remaining 309 concrete has been shown to be limited to the upper portion of the remaining concrete mass. An intact concrete matrix is generally not amenable to leaching studies. Therefore, available lines of evidence for leaching behavior are based upon leaching of pulverized matrices and conceptual modeling of a solid form. Constituents are expected to leach more readily from a pulverized matrix than an intact large mass, so application of associated data is conservative. Leaching studies on grouted waste forms performed by Pacific Northwest National Laboratory (Serne, et al., 1992) showed that hexavalent chromium had strong reactions in a cementious matrix, likely substituting into sulfate-bearing cement materials such as calcium monosulfate and ettringite. Conceptual model efforts for describing the transport of contaminants through a porous media such as concrete calculated a Kd of 870 ml/g for hexavalent chromium (Krupka and Serne 1996). This Kd value has been used to support leaving subsurface concrete structural components contaminated with hexavalent chromium in-place elsewhere in the River Corridor (e.g., the 183-KW clearwells). Using TCLP leaching data from samples of hexavalent chromium-contaminated concrete collected from the 183-H clearwells, Kd values of 28.3 – 50.6 mL/g were calculated. TCLP leaching of a pulverized matrix represents significantly more aggressive leaching than would occur in an intact concrete mass, but even these values demonstrate low contaminant leachability. The residual hexavalent chromium at the remaining 309 foundation is also restricted to the upper portion of the remaining concrete; underlying concrete between 13 and 20 feet thick further restricts any potential contaminant mobility.

Lastly, given the size of the existing monolithic concrete structure, significant degradation of the foundation is not considered credible. Underground concrete is not subject to freeze-thaw cycles and other weather forces acknowledged to degrade concrete.

It is Concluded, residual Cr(VI) in the concrete will be protective of the water quality criteria for the Columbia River. This determination will be documented with the Facility Status Change Form for the 309 facility.

Attachment 1

309 Deep Zone Characterization - Structure
- 32-Foot Sampling Summary -

The tables below include only those contaminants of concern (COCs) at detectable levels with corresponding deep zone (ground water and river protectiveness) cleanup levels (CULs). Volatile, semi-volatile, and polychlorinated biphenyl constituents were not identified as COCs and were not included in sample analysis.

Table 1. Core #1

Sample Location	Contaminant of Concern	Result	Cleanup Level
Core Surface (J1V1T4)	Cr(VI)	1.18 mg/kg	2.0 mg/kg
Core Surface (J1V1R4)	Uranium (total)	0.0226 ug/kg 0.0139 ug/g (DUP)	175 mg/kg
Core Surface (J1V1R4)	Tritium	70.9 pCi/g 67.7 pCi/g (DUP)	12,200 pCi/g
Core Bottom (J1V1V4)	Tritium	131 pCi/g 126 pCi/g (DUP)	12,200 pCi/g
Core Surface (J1V1R4)	Antimony	1.43 mg/kg	760 mg/kg
Core Surface (J1V1R4)	Selenium	1.15 mg/kg	912 mg/kg
Core Surface (J1V1R4)	TPH – motor oil	**9670 mg/kg**	2000 mg/kg
Core Surface (J1V1R4)	TPH – diesel range	795 mg/kg	2000 mg/kg
TPH Resample (J1V3N7) following initial decontamination.	TPH – motor oil	**10400 mg/kg**	2000 mg/kg
TPH Resample (following initial decontamination)	TPH – diesel range	686 mg/kg	2000 mg/kg
TPH Resample (J1V3N7) following final decontamination.	TPH – motor oil	686 mg/kg	2000 mg/kg
TPH Resample (J1V428) following final decontamination	TPH – diesel range	54 mg/kg	2000 mg/kg

Table 2. Core #2

Sample Location	Contaminant of Concern	Result	Cleanup Level
Core Surface (J1V1T5)	Cr(VI)	**2.85 mg/kg**	2.0 mg/kg
Core Surface (J1V1R5)	Uranium (total)	0.0261 ug/g	175 mg/kg
Core Surface (J1V1R5)	Tritium	1,330 pCi/g	12,200 pCi/g
Core Bottom (J1V1V5)	Tritium	2,070 pCi/g	12,200 pCi/g

Core Surface (J1V1R5)	Antimony	0.890 mg/kg	760 mg/kg
Core Surface (J1V1R5)	Selenium	1. 85 mg/kg	912 mg/kg
Core Surface (J1V1R5)	TPH – motor oil	722 mg/kg	2000 mg/kg
Core Surface (J1V1R5)	TPH – diesel range	126 mg/kg	2000 mg/kg

Table 3. Core #3

Sample Location	Contaminant of Concern	Result	Cleanup Level
Core Surface (J1V1T6)	Cr(VI)	2.76 mg/kg	2.0 mg/kg
Core Surface (J1V1R6)	Uranium (total)	0.0143 ug/g	175 mg/kg
Core Surface (J1V1R6)	Tritium	117 pCi/g	12,200 pCi/g
Core Bottom (J1V1V6)	Tritium	25.9 pCi/g	12,200 pCi/g
Core Surface (J1V1R6)	Selenium	1. 24 mg/kg	912 mg/kg
Core Surface (J1V1R6)	TPH – motor oil	395 mg/kg	2000 mg/kg
Core Surface (J1V1R6)	TPH – diesel range	920 mg/kg	2000 mg/kg

Table 4. Core #4

Sample Location	Contaminant of Concern	Result	Cleanup Level
Core Surface (J1V1T7)	Cr(VI)	0.758 mg/kg	2.0 mg/kg
Core Surface (J1V1R7)	Uranium (total)	0.103 ug/g	175 mg/kg
Core Bottom (J1V1V7)	Tritium	79.1 pCi/g	12,200 pCi/g
Core Surface (J1V1R7)	Selenium	0.820 mg/kg	912 mg/kg
Core Surface (J1V1R7)	TPH – motor oil	229 mg/kg	2000 mg/kg
Core Surface (J1V1R7)	TPH – diesel range	28.2 mg/kg	2000 mg/kg

Table 5. Core #5

Sample Location	Contaminant of Concern	Result	Cleanup Level
Core Surface (J1V1T8)	Cr(VI)	2.38 mg/kg	2.0 mg/kg
Core Middle (J1V1253)	Cr(VI)	0.173 mg/kg 0.155 mg/kg (DUP)	2.0 mg/kg
Core Surface (J1V1R8)	Uranium (total)	0.117 ug/g	175 mg/kg
Core Surface (J1V1R8)	Tritium	910 pCi/g	12,200 pCi/g
Core Bottom (J1V1V8)	Tritium	442 pCi/g	12,200 pCi/g
Core Surface (J1V1R8)	Nitrate	0.367 mg/kg	21,000 mg/kg
Core Surface (J1V1R8)	Selenium	1. 64 mg/kg	912 mg/kg
Core Surface (J1V1R8)	TPH – motor oil	471 mg/kg	2000 mg/kg
Core Surface (J1V1R8)	TPH – diesel range	172 mg/kg	2000 mg/kg

Table 6. Core #6

Sample Location	Contaminant of Concern	Result	Cleanup Level
Core Surface (J1V1T9)	Cr(VI)	3.49 mg/kg	2.0 mg/kg
Core Surface (J1V1R9)	Uranium (total)	0.041 ug/g	175 mg/kg
Core Surface (J1V1R9)	Tritium	3,180 pCi/g	12,200 pCi/g
Core Bottom (J1V1V9)	Tritium	1,140 pCi/g	12,200 pCi/g
Core Surface (J1V1R9)	Nitrate	0.206 mg/kg	21,000 mg/kg
Core Surface (J1V1R9)	Selenium	1. 02 mg/kg	912 mg/kg
Core Surface (J1V1R9)	TPH – motor oil	319 mg/kg	2000 mg/kg
Core Surface (J1V1R9)	TPH – diesel range	123 mg/kg	2000 mg/kg

Table 7. Core #7

Sample Location	Contaminant of Concern	Result	Cleanup Level
Core Surface (J1V1V0)	Cr(VI)	3.18 mg/kg	2.0 mg/kg
Core Surface (J1V1R9)	Uranium (total)	0.0768 ug/g	175 mg/kg
Core Surface (J1V1R9)	Tritium	1,260 pCi/g	12,200 pCi/g
Core Bottom (J1V1W0)	Tritium	3,410 pCi/g	12,200 pCi/g
Core Surface (J1V1T0)	Antimony	0.966\ mg/kg	760 mg/kg
Core Surface (J1V1T0)	Selenium	0.802 mg/kg	912 mg/kg
Core Surface (J1V1T0)	TPH – motor oil	857 mg/kg	2000 mg/kg
Core Surface (J1V1T0)	TPH – diesel range	618 mg/kg	2000 mg/kg

Table 8. Core #8

Sample Location	Contaminant of Concern	Result	Cleanup Level
Core Surface (J1V1V1)	Cr(VI)	1.75 mg/kg	2.0 mg/kg
Core Surface (J1V1T1)	Uranium (total)	0.0678 ug/g	175 mg/kg
Core Surface (J1V1T1)	Tritium	243 pCi/g	12,200 pCi/g
Core Bottom (J1V1W1)	Tritium	156 pCi/g	12,200 pCi/g
Core Surface (J1V1T1)	Nitrate	0.199 mg/kg	21,000 mg/kg
Core Surface (J1V1T1)	Selenium	1.51 mg/kg	912 mg/kg
Core Surface (J1V1T1)	TPH – motor oil	508 mg/kg	2000 mg/kg
Core Surface (J1V1T1)	TPH – diesel range	803 mg/kg	2000 mg/kg

Table 9. Core #9

Sample Location	Contaminant of Concern	Result	Cleanup Level
Core Surface (J1V1V2)	Cr(VI)	2.07 mg/kg	2.0 mg/kg
Core Surface (J1V1T2)	Uranium (total)	0.0392 ug/g	175 mg/kg
Core Surface (J1V1T2)	Tritium	53.9 pCi/g	12,200 pCi/g
Core Bottom (J1V1W2)	Tritium	16.6 pCi/g	12,200 pCi/g
Core Surface (J1V1T2)	Selenium	1.25 mg/kg	912 mg/kg

Core Surface (J1V1T2)	TPH – motor oil	184 mg/kg	2000 mg/kg
Core Surface (J1V1T2)	TPH – diesel range	898 mg/kg	2000 mg/kg

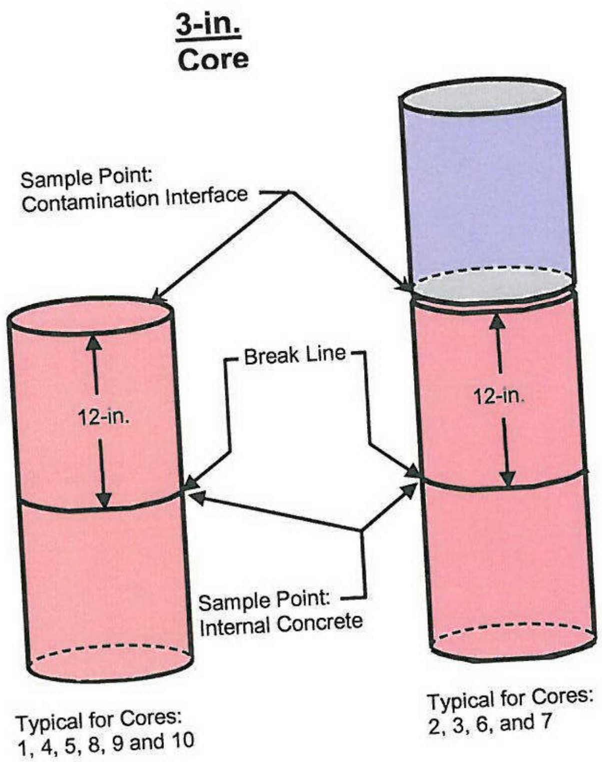
Table 10. Core #10

Sample Location	Contaminant of Concern	Result	Cleanup Level
Core Surface (J1V1V3)	Cr(VI)	**3.68 mg/kg** **4.58 mg/kg (DUP)**	2.0 mg/kg
Core Middle (J1V1254)	Cr(VI)	0.974 mg/kg	2.0 mg/kg
Core Surface (J1V1T3)	Uranium (total)	0.0746 ug/g	175 mg/kg
Core Surface (J1V1T3)	Tritium	110 pCi/g	12,200 pCi/g
Core Bottom (J1V1W3)	Tritium	2,320 pCi/g	12,200 pCi/g
Core Surface (J1V1T3)	Nitrate	0.199 mg/kg	21,000 mg/kg
Core Surface (J1V1T3)	Selenium	1.96 mg/kg	912 mg/kg
Core Surface (J1V1T3)	TPH – motor oil	229 mg/kg	2000 mg/kg
Core Surface (J1V1T3)	TPH – diesel range	28.2 mg/kg	2000 mg/kg

Table 11. Other Focused Samples

Sample Location	Contaminant of Concern	Result	Cleanup Level
Surface @ -32' (J1V310)	Cr(VI)	**6.35 mg/kg** **5.05 mg/kg (DUP)**	2.0 mg/kg
Surface @ -32' (J1V315)	Cr(VI)	**5.32 mg/kg**	2.0 mg/kg
Surface @ -32' (J1V316)	Cr(VI)	**9.20 mg/kg**	2.0 mg/kg
Surface @ -32' (J1V317)	Cr(VI)	**2.21 mg/kg**	2.0 mg/kg
Surface @ -32' (J1V318)	Cr(VI)	**7.15 mg/kg**	2.0 mg/kg

Figure 1. 309 -32 Foot Core Locations, Section View
(Note: Remaining foundation dimensions are 80 feet in diameter and 20 feet in depth at maximum extent. Figure not to scale)



Core Sample Depth (from -32'):

- Cores 1, 4, 5, 8, 9 and 10 = Approx. 2-ft.
- Core 2 = Approx. 9-ft.
- Cores 3, 6 and 7 – Approx. 12-ft.

Note:

- Figures illustrate sample locations specific to the 309 PRTR below-grade containment structure.
- Hexavalent chromium results greater than deep zone CULs are highlighted in red.
- Highlighted values are of samples collected from the top of Containment Concrete (Contamination Interface).
- Locations #5 & #10 were re-sampled at the internal Sample Point to determine if elevated chromium values were inherent to the original structural concrete. Reported results do not support this correlation.

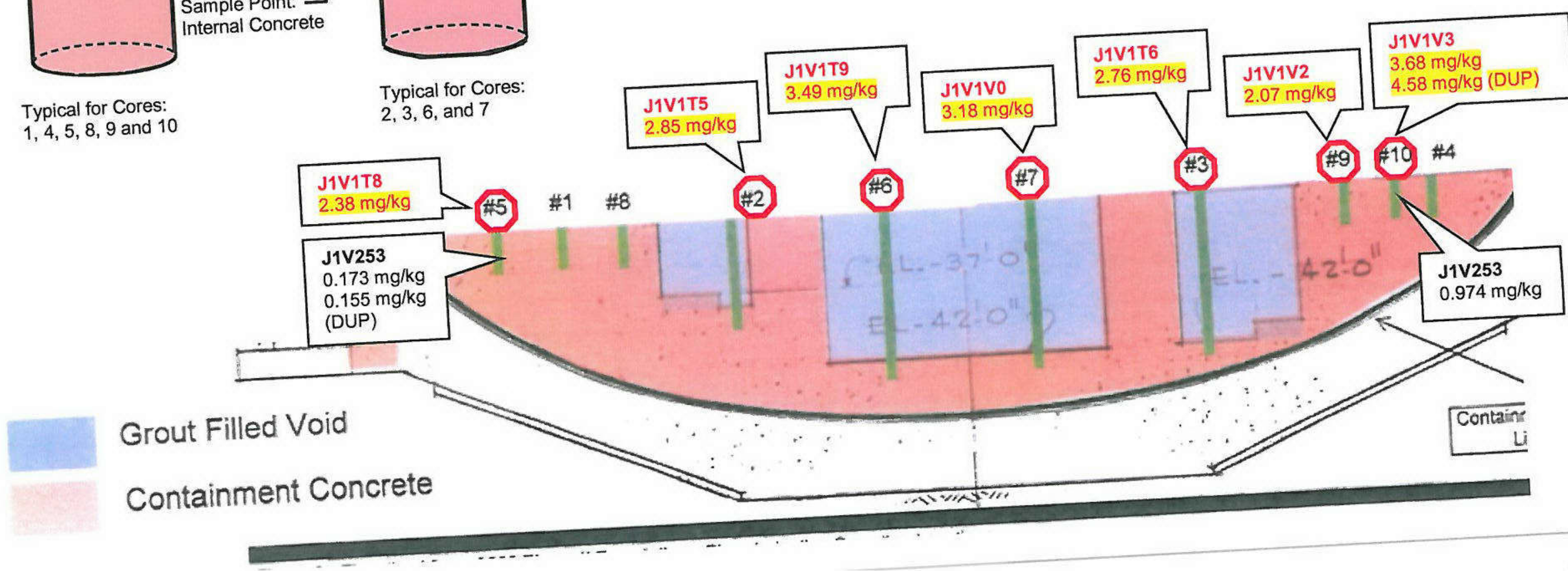


Figure 2. 309 -32 Foot Core Locations, Plan View

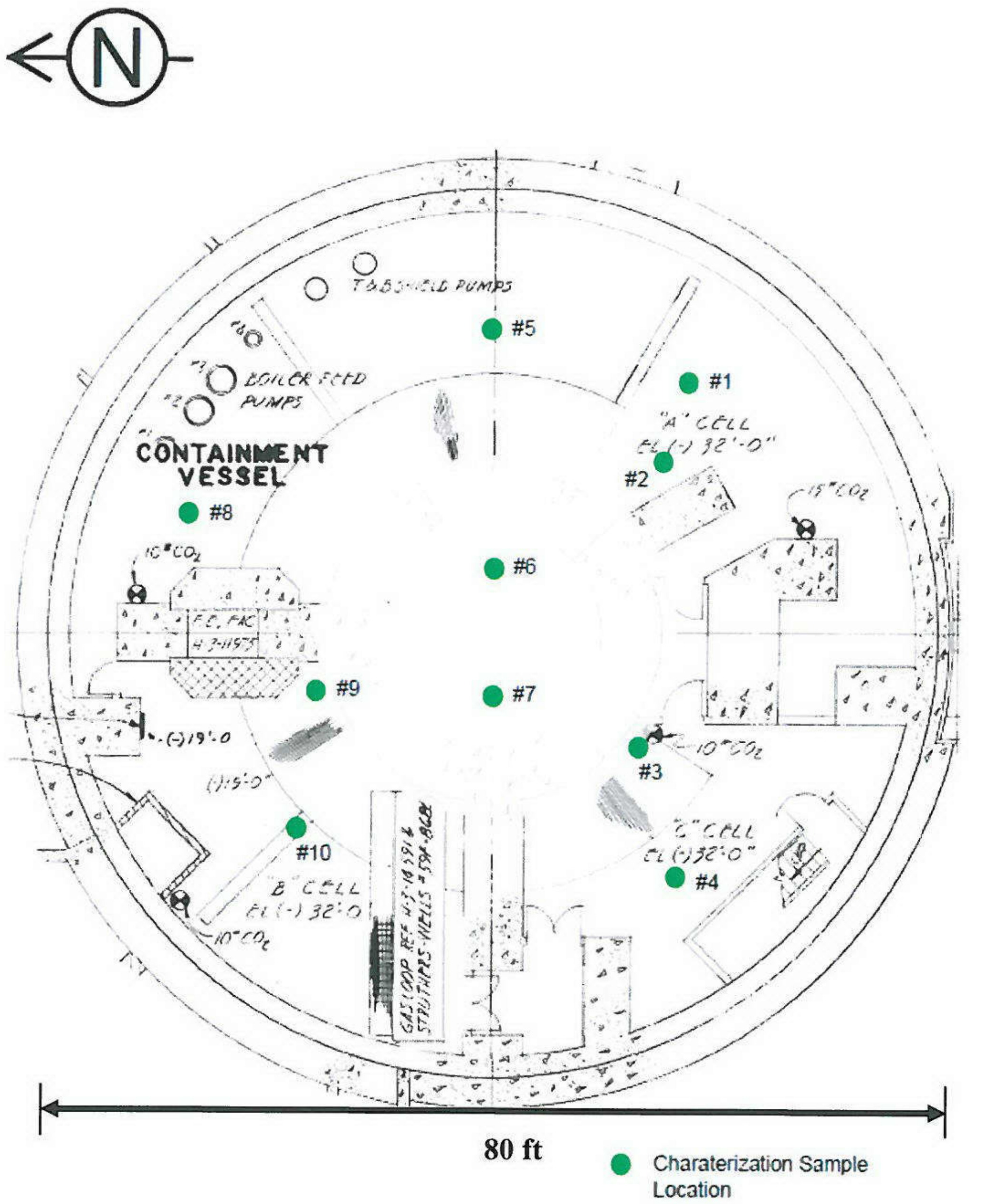
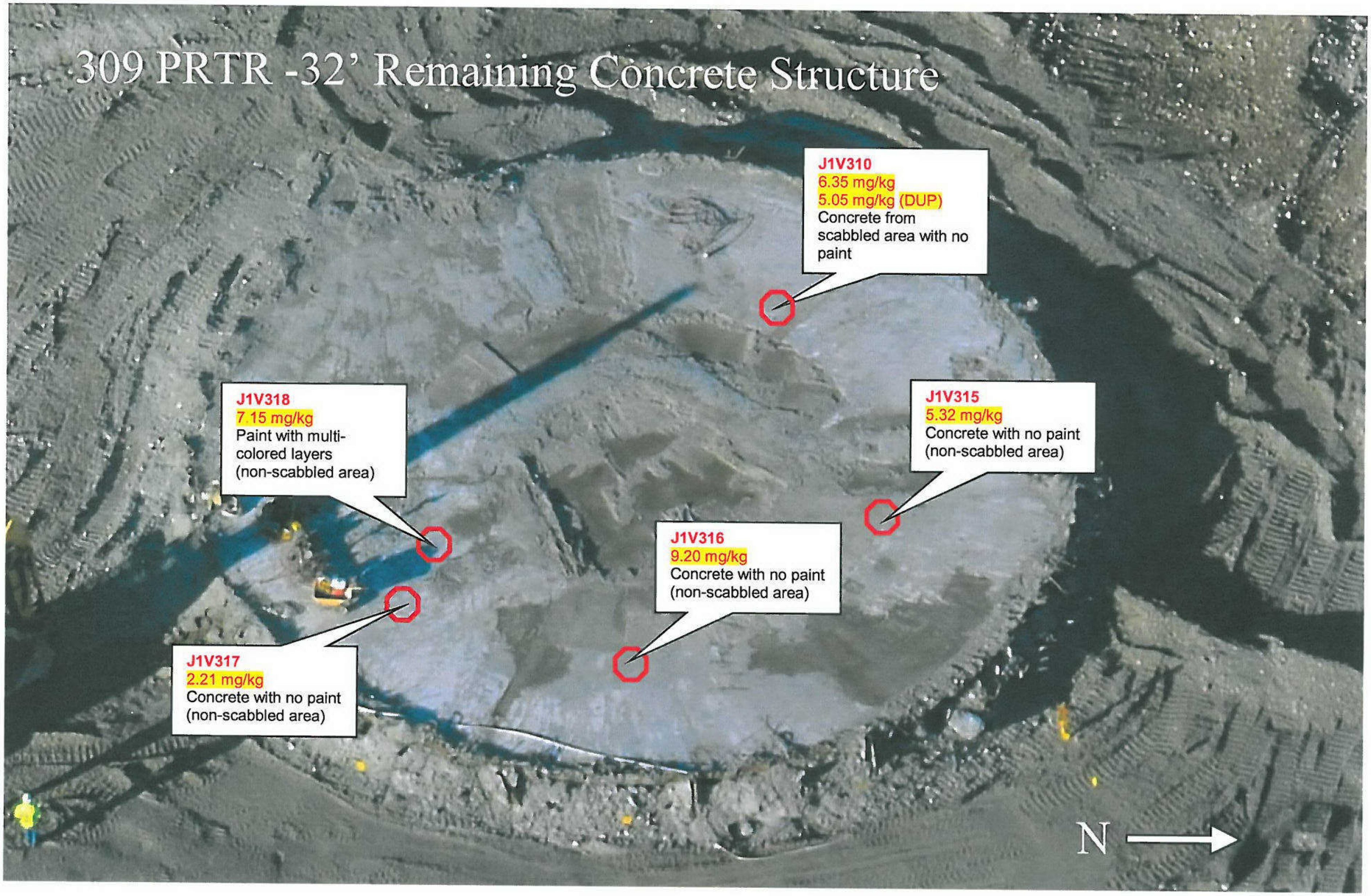


Figure 1 - Plan View of 309 Phase II Foundation - Charaterization Sampling Locations NTS

Figure 3. 309 -32 Foot Other Samples with Cr 6+ Detections



Attachment 2

309 Deep Zone Characterization - Soil
- 32-Foot Sampling Summary -

The tables below include only those contaminants of concern (COCs) at detectable levels with corresponding deep zone (ground water and river protectiveness) cleanup levels (CULs). Volatile, semi-volatile, and polychlorinated biphenyl constituents were not identified as COCs and were not included in sample analysis.

Table 1. Test Pit 1, Ion Exchange Vault

Sample Elevation	Contaminant of Concern	Result	Cleanup Level
-41 ft TP 1-1 (J1V1W4)	Uranium (total)	0.598 mg/kg	157 mg/kg
	Uranium (total) DUP	0.547 mg/kg	157 mg/kg
	Cs-137	0.961 pCi/g	N/A
	Cs-137 DUP	1.00 pCi/g	N/A
	Eu-155	0.359 pCi/g	N/A
	Eu-155 DUP	ND	N/A
	Cr^{6+}	0.379 mg/kg	2.0 mg/kg
	Arsenic	2.85 mg/kg	N/A
	Barium	66.2 mg/kg	N/A
	Beryllium	1.42 mg/kg	N/A
	Cadmium	0.188 mg/kg	N/A
	Chromium (total)\	8.28 mg/kg	N/A
	Cobalt	10.9 mg/kg	N/A
	Copper	8.93 mg/kg	N/A
	Lithium	6.75 mg/kg	N/A
	Manganese	289 mg/kg	N/A
	Nickel	9.90 mg/kg	N/A
	Selenium	1.21 mg/kg	912 mg/kg
	Vanadium	60.4 mg/kg	N/A
	Zinc	38.5 mg/kg	N/A
	TPH – motor oil	16.3 mg/kg	2,000 mg/kg
-50 ft TP 1-2 (J1V1W5)	Uranium (total)	0.455 mg/kg	157 mg/kg
	Strontium (total)	0.657 pCi/g	N/A
	Cs-137	0.883 pCi/g	N/A
	Cr^{6+}	0.132 mg/kg	2.0 mg/kg
	Nitrate	0.633 mg/kg	21,000 mg/kg
	Arsenic	3.11 mg/kg	N/A
	Barium	66.9 mg/kg	N/A
	Beryllium	1.43 mg/kg	N/A
	Cadmium	0.279 mg/kg	N/A
	Chromium (total)\	7.78 mg/kg	N/A
	Cobalt	11.5 mg/kg	N/A
	Copper	8.40 mg/kg	N/A
	Lithium	6.06 mg/kg	N/A

	Manganese	295 mg/kg	N/A
	Nickel	9.91 mg/kg	N/A
	Selenium	1.12 mg/kg	912 mg/kg
	Vanadium	63.8 mg/kg	N/A
	Zinc	34.2 mg/kg	N/A
	TPH – motor oil	8.80 mg/kg	2,000 mg/kg
-57 ft TP 1-3 (J1V1W6)	Uranium (total)	0.851 mg/kg	157 mg/kg
	U-238	2.26 pCi/g	N/A
	Cr^{6+}	0.204 mg/kg	2.0 mg/kg
	Nitrate	0.898 mg/kg	21,000 mg/kg
	Arsenic	3.58 mg/kg	N/A
	Barium	112 mg/kg	N/A
	Beryllium	1.78 mg/kg	N/A
	Cadmium	0.518 mg/kg	N/A
	Chromium (total)\	5.87 mg/kg	N/A
	Cobalt	17.9 mg/kg	N/A
	Copper	11.2 mg/kg	N/A
	Lithium	11.6 mg/kg	N/A
	Manganese	498 mg/kg	N/A
	Nickel	8.54 mg/kg	N/A
	Selenium	1.45 mg/kg	912 mg/kg
	Tin	3.85 mg/kg	N/A
	Vanadium	70.6 mg/kg	N/A
	Zinc	35.8 mg/kg	N/A
	TPH – motor oil	4.02 mg/kg	2,000 mg/kg

Table 2. Test Pit 2, Fuel Storage Basin, North

Sample Elevation	Contaminant of Concern	Result	Cleanup Level
-43 ft TP 2-1 (J1V1W7)	Uranium (total)	0.607 mg/kg	157 mg/kg
	Nitrate	1.09 mg/kg	21,000 mg/kg
	Arsenic	1.91 mg/kg	N/A
	Barium	55.6 mg/kg	N/A
	Beryllium	1.57 mg/kg	N/A
	Cadmium	0.400 mg/kg	N/A
	Chromium (total)\	2.05 mg/kg	N/A
	Cobalt	15.2 mg/kg	N/A
	Copper	12.6 mg/kg	N/A
	Lithium	3.65 mg/kg	N/A
	Manganese	272 mg/kg	N/A
	Nickel	6.27 mg/kg	N/A
	Selenium	1.36 mg/kg	912 mg/kg
	Vanadium	68.4 mg/kg	N/A
	Zinc	38.8 mg/kg	N/A
	TPH – motor oil	13.0 mg/kg	2,000 mg/kg
-52 ft TP 2-2 (J1V1W8)	Uranium (total)	0.832 mg/kg	157 mg/kg
	U-238	2.65 pCi/g	N/A

	Nitrate Arsenic Barium Beryllium Cadmium Chromium (total)\ Cobalt Copper Lithium Manganese Nickel Selenium Tin Vanadium Zinc TPH – motor oil	0.468 mg/kg 5.55 mg/kg 153 mg/kg 2.30 mg/kg 0.116 mg/kg 10.0 mg/kg 17.3 mg/kg 12.2 mg/kg 13.0 mg/kg 525 mg/kg 12.4 mg/kg 1.65 mg/kg 4.53 mg/kg 85.6 mg/kg 41.8 mg/kg 4.99 mg/kg	21,000 mg/kg N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A 912 mg/kg N/A N/A N/A 2,000 mg/kg
-60 ft TP 2-3 (J1V1W9)	Uranium (total) Nitrate Arsenic Barium Beryllium Cadmium Chromium (total)\ Cobalt Copper Lithium Manganese Nickel Selenium Vanadium Zinc TPH – motor oil	0.950 mg/kg 0.313 mg/kg 4.50 mg/kg 169 mg/kg 2.30 mg/kg 0.217 mg/kg 8.69 mg/kg 17.1 mg/kg 12.3 mg/kg 13.0 mg/kg 531 mg/kg 12.1 mg/kg 1.86 mg/kg 81.4 mg/kg 40.1 mg/kg 2.92 mg/kg	157 mg/kg 21,000 mg/kg N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A 912 mg/kg N/A N/A 2,000 mg/kg

Table 3. Test Pit 3, Critical Test Facility

Sample Elevation	Contaminant of Concern	Result	Cleanup Level
-41 ft TP 3-1 (J1V1X0)	Uranium (total) Eu-155 Tritium Arsenic Barium Beryllium Cadmium Chromium (total)\ Cobalt Copper Lithium	0.407 mg/kg 0.265 pCi/g 6.83 pCi/g 1.81 mg/kg 71.6 mg/kg 1.69 mg/kg 0.607 mg/kg 3.53 mg/kg 15.0 mg/kg 11.9 mg/kg 6.96 mg/kg	157 mg/kg N/A 12,200 pCi/g N/A N/A N/A N/A N/A N/A N/A N/A

	Manganese Nickel Selenium Vanadium Zinc TPH – motor oil	318 mg/kg 7.39 mg/kg 1.48 mg/kg 71.9 mg/kg 35.11 mg/kg 11.8 mg/kg	N/A N/A 912 mg/kg N/A N/A 2,000 mg/kg
-50 ft TP 3-2 (J1V1X1)	Uranium (total) Arsenic Barium Beryllium Cadmium Chromium (total)\ Cobalt Copper Lithium Manganese Nickel Selenium Vanadium Zinc TPH – motor oil	0.569 mg/kg 0.707 mg/kg 53.3 mg/kg 1.74 mg/kg 0.609 mg/kg 1.93 mg/kg 15.8 mg/kg 12.1 mg/kg 3.18 mg/kg 313 mg/kg 6.08 mg/kg 1.60 mg/kg 75.9 mg/kg 37.4 mg/kg 4.02 mg/kg	157 mg/kg N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A 912 mg/kg N/A N/A 2,000 mg/kg
-58 ft TP 3-3 (J1V1X2)	Uranium (total) Nitrate Arsenic Barium Beryllium Cadmium Chromium (total)\ Cobalt Copper Lithium Manganese Nickel Selenium Tin Vanadium Zinc TPH – motor oil	0.614 mg/kg 0.653 mg/kg 2.57 mg/kg 131 mg/kg 2.18 mg/kg 0.287 mg/kg 5.50 mg/kg 17.7 mg/kg 11.9 mg/kg 6.35 mg/kg 416 mg/kg 9.45 mg/kg 1.71 mg/kg 3.34 mg/kg 88.7 mg/kg 41.6 mg/kg 2.92 mg/kg	157 mg/kg 21,000 mg/kg N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A 912 mg/kg N/A N/A N/A 2,000 mg/kg

Table 4. Test Pit 4, Fuel Storage Basin, South

Sample Elevation	Contaminant of Concern	Result	Cleanup Level
-41 ft TP 4-1 (J1V1X3)	Uranium (total) Cr^{6+} Arsenic Barium Beryllium	0.827 mg/kg 0.234 mg/kg 0.612 mg/kg 62.8 mg/kg 2.02 mg/kg	157 mg/kg 2.0 mg/kg N/A N/A N/A

	Cadmium	0.792 mg/kg	N/A
	Chromium (total)\	2.81 mg/kg	N/A
	Cobalt	18.4 mg/kg	N/A
	Copper	10.4 mg/kg	N/A
	Lithium	3.83 mg/kg	N/A
	Manganese	328 mg/kg	N/A
	Nickel	6.37 mg/kg	N/A
	Selenium	1.57 mg/kg	912 mg/kg
	Vanadium	90.9 mg/kg	N/A
	Zinc	40.2 mg/kg	N/A
-50 ft TP 4-2 (J1V1X4)	Uranium (total)	0.836 mg/g	157 mg/kg
	U-238	1.96 pCi/g	N/A
	Nitrate	5.66 mg/kg	21,000 mg/kg
	Arsenic	2.57 mg/kg	N/A
	Barium	157 mg/kg	N/A
	Beryllium	2.23 mg/kg	N/A
	Cadmium	0.988 mg/kg	N/A
	Chromium (total)\	6.89 mg/kg	N/A
	Cobalt	17.4 mg/kg	N/A
	Copper	13.1 mg/kg	N/A
	Lithium	8.93 mg/kg	N/A
	Manganese	429 mg/kg	N/A
	Nickel	9.21 mg/kg	N/A
	Selenium	1.32 mg/kg	912 mg/kg
	Vanadium	85.2 mg/kg	N/A
	Zinc	46.4 mg/kg	N/A
	TPH – motor oil	4.20 mg/kg	2,000 mg/kg
-58 ft TP 4-3 (J1V1X5)	Uranium (total)	0.839 mg/kg	157 mg/kg
	Nitrate	1.74 mg/kg	21,000 mg/kg
	Arsenic	3.16 mg/kg	N/A
	Barium	108 mg/kg	N/A
	Beryllium	2.08 mg/kg	N/A
	Cadmium	0.263 mg/kg	N/A
	Chromium (total)\	6.27 mg/kg	N/A
	Cobalt	16.7 mg/kg	N/A
	Copper	10.7 mg/kg	N/A
	Lithium	10.0 mg/kg	N/A
	Manganese	407 mg/kg	N/A
	Nickel	9.60 mg/kg	N/A
	Selenium	1.53 mg/kg	912 mg/kg
	Vanadium	82.6 mg/kg	N/A
	Zinc	39.5 mg/kg	N/A
	TPH – motor oil	5.88 mg/kg	2,000 mg/kg

Table 5. Test Pit 5, Rupture Loop Annex, South

Sample Elevation	Contaminant of Concern	Result	Cleanup Level
-40 ft TP 5-1 (J1V1X6)	Uranium (total)	0.595 mg/kg	157 mg/kg
	I-129	0.026 pCi/g	37.1 pCi/g
	Tritium	15.6 pCi/g	12,200 pCi/G
	Cr^{6+}	0.164 mg/kg	2.0 mg/kg
	Arsenic	5.04 mg/kg	N/A
	Barium	69.3 mg/kg	N/A
	Beryllium	1.75 mg/kg	N/A
	Cadmium	0.586 mg/kg	N/A
	Chromium (total)\	4.84 mg/kg	N/A
	Cobalt	14.4 mg/kg	N/A
	Copper	12.9 mg/kg	N/A
	Lithium	7.24 mg/kg	N/A
	Manganese	332 mg/kg	N/A
	Nickel	7.83 mg/kg	N/A
	Selenium	1.34 mg/kg	912 mg/kg
	Vanadium	73.7 mg/kg	N/A
	Zinc	43.9 mg/kg	N/A
	TPH – motor oil	5.16 mg/kg	2,000 mg/kg
-44 ft TP 5-2 (J1V1X7)	Uranium (total)	0. 607 mg/kg	157 mg/kg
	Eu-155	0.111 pCi/g	N/A
	U-238	0.821 pCi/g	N/A
	Tritium	8.0 pCi/g	12,200 pCi/g
	Nitrate	0.193 mg/kg	21,000 mg/kg
	Arsenic	0.771 mg/kg	N/A
	Barium	28.2 mg/kg	N/A
	Beryllium	0.953 mg/kg	N/A
	Cadmium	0.162 mg/kg	N/A
	Chromium (total)\	0.381 mg/kg	N/A
	Cobalt	7.45 mg/kg	N/A
	Copper	6.21 mg/kg	N/A
	Lithium	2.47 mg/kg	N/A
	Manganese	139 mg/kg	N/A
	Nickel	3.31 mg/kg	N/A
	Selenium	1.12 mg/kg	912 mg/kg
	Vanadium	29.2 mg/kg	N/A
	Zinc	15.0 mg/kg	N/A
	TPH – motor oil	2.90 mg/kg	2,000 mg/kg
-49 ft TP 5-3 (J1V1X8)	Uranium (total)	0.794 mg/kg	157 mg/kg
	Tritium	9.06 pCi/g	12,200 pCi/g
	Arsenic	2.99 mg/kg	N/A
	Barium	98.9 mg/kg	N/A
	Beryllium	1.81 mg/kg	N/A
	Cadmium	0.563 mg/kg	N/A
	Chromium (total)\	5.27 mg/kg	N/A
	Cobalt	15.2 mg/kg	N/A

	Copper Lithium Manganese Nickel Selenium Vanadium Zinc TPH – motor oil	10.6 mg/kg 9.21 mg/kg 398 mg/kg 8.38 mg/kg 1.47 mg/kg 67.8 mg/kg 37.4 mg/kg 3.99 mg/kg	N/A N/A N/A N/A 912 mg/kg N/A N/A 2,000 mg/kg

Table 6. Test Pit 6

Sample Elevation	Contaminant of Concern	Result	Cleanup Level
-35 ft TP 6-1 (J1V1X9)	Uranium (total) U-238 Tritium Nitrate Arsenic Barium Beryllium Cadmium Chromium (total)\ Cobalt Copper Lithium Manganese Nickel Selenium Vanadium Zinc TPH – motor oil	0.388 mg/kg 1.15 pCi/g 1.27 pCi/g 2.88 mg/kg 3.08 mg/kg 63.6 mg/kg 1.35 mg/kg 0.297 mg/kg 6.38 mg/kg 10.8 mg/kg 15.3 mg/kg 6.74 mg/kg 289 mg/kg 7.80 mg/kg 1.25 mg/kg 53.9 mg/kg 35.2 mg/kg 6.82 mg/kg	157 mg/kg N/A 12,200 pCi/g 21,000 mg/kg N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A 912 mg/kg N/A N/A 2,000 mg/kg
-44 ft TP 6-2 (J1V200)	Uranium (total) U-238 Tritium Cr^{6+} Nitrate Arsenic Barium Beryllium Cadmium Chromium (total)\ Cobalt Copper Lithium Manganese Nickel Selenium Vanadium	0.708 mg/g 1.63 pCi/g 1.0 pCi/g 0.225 mg/kg 0.388 mg/kg 3.41 mg/kg 67.9 mg/kg 1.76 mg/kg 0.283 mg/kg 5.24 mg/kg 13.4 mg/kg 8.34 mg/kg 6.12 mg/kg 314 mg/kg 9.06 mg/kg 0.990 mg/kg 72.1 mg/kg	157 mg/kg N/A 12,200 pCi/g 2.0 mg/kg 21,000 mg/kg N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A 912 mg/kg N/A

	Zinc TPH – motor oil	32.9 mg/kg 4.02 mg/kg	N/A 2,000 mg/kg
-49 ft TP 6-3 (J1V201)	Uranium (total) Tc-99 Nitrate Arsenic Barium Beryllium Cadmium Chromium (total)\ Cobalt Copper Lithium Manganese Nickel Selenium Vanadium Zinc TPH – motor oil	0.725 mg/kg 1.35 pCi/g 0.446 mg/kg 3.94 mg/kg 112 mg/kg 1.73 mg/kg 0.660 mg/kg 5.97 mg/kg 14.1 mg/kg 10.3 mg/kg 10.8 mg/kg 411 mg/kg 8.74 mg/kg 1.32 mg/kg 65.7 mg/kg 40.0 mg/kg 3.34 mg/kg	157 mg/kg 420 pCi/g 21,000 mg/kg N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A 912 mg/kg N/A N/A 2,000 mg/kg

Note: Elevation differences are based on differences in starting elevations for each test pit.

Attachment 2, Figure 1. 309 Test Pit Locations